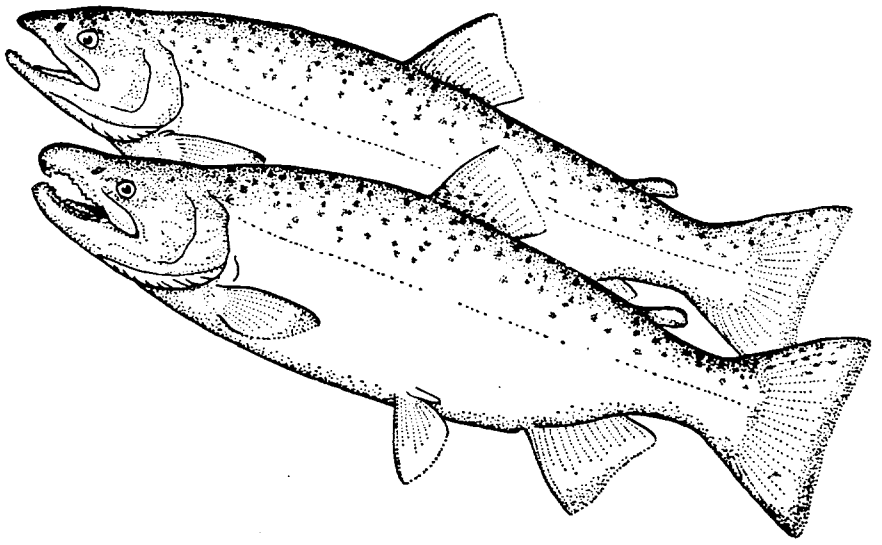
Escapement Goals for Coho Salmon Stocks Returning to Streams Located Along the Juneau Road System of Southeast Alaska



By

John H. Clark

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Alaska Department of Fish and Game
Division of Commercial Fisheries Management and Development
Juneau, Alaska

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AUTHOR

John H. Clark is a fishery biologist employed by the Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Capital Office Park, 1255 West 8th Street, Post Office Box 25526, Juneau, Alaska.

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ABSTRACT

Abundance of coho salmon *Oncorhynchus kisutch* in the escapements of Jordan, Montana, Petersen, Steep, and Switzer creeks of Southeast Alaska have been indexed by on-the-ground stream surveys conducted by staff of the Alaska Department of Fish and Game since the early 1980's. A nearby population of coho salmon resident to Auke Creek has been extensively monitored to estimate marine harvest rate and these annual rates are believed to be applicable to other nearby coho salmon populations which are subjected to similar fisheries. These and other available data were modeled to develop spawner-recruit relationships. Spawner-recruit relationships were used to develop estimates of the escapement levels needed to provide for maximum sustained harvests of the Jordan, Montana, Petersen, Steep, and Switzer creek stocks of coho salmon. In addition to the spawner-recruit analyses, estimates of maximum sustained yield escapement levels for these five stocks were derived from exploitation rate and proportional escapements analyses as well as with an approach based upon rearing area. Assumptions associated with each of the analyses are provided and resulting estimates of the indicated biological escapement goals are discussed. Recommendations concerning biological escapement goals for the coho salmon stocks that return to Jordan, Montana, Petersen, Steep and Switzer creeks were made and these recommendations follow:

	Recommended Goals (Peak Counts of Index Spawners)	
Stream	Point Escapement Goals	Escapement Goal Ranges
Jordan Creek	150	75 to 200
Montana Creek	450	200 to 500
Petersen Creek	200	100 to 350
Steep Creek	150	100 to 300
Switzer Creek	50	25 to 75

The Alaska Department of Fish and Game adopted these recommendations and formally established biological escapement goals for the Jordan, Montana, Petersen, Steep, and Switzer creek stocks of coho salmon on September 19, 1994.

KEY WORDS: coho salmon, *Oncorhynchus kisutch*, Southeast Alaska, brood tables, spawner-recruit, escapement goals, Jordan Creek, Montana Creek, Petersen Creek, Steep Creek, Switzer Creek

INTRODUCTION

Sport Fish Division of the Alaska Department of Fish and Game (ADF&G) has been conducting surveys of spawning populations of coho salmon returning to streams located along the Juneau road system of Southeast Alaska since 1980. Stream populations of coho salmon along the Juneau road system which ADF&G staff annually survey include Jordan Creek, Montana Creek, Petersen Creek, Steep Creek, and Switzer Creek. Although spawner abundance in these five streams has been annually monitored, biological escapement goals (BEG) were not adopted by ADF&G prior to 1994.

Sport Fish Division of ADF&G annually finances the coho salmon stock monitoring program conducted at Auke Creek. This program consists of operating a weir that is used for enumerating the spawning escapement and sampling the age-sex-size composition of the spawning population of adult coho salmon migrating into Auke Creek. The Auke Creek weir is also used to collect emigrating coho salmon smolt. Collected smolt are sampled for age-sex-size composition, tagged with micro-wire tags (CWT) and given an adipose fin clip. Through port sampling activities conducted by ADF&G staff for fisheries that take place throughout Southeast Alaska, heads from harvested coho salmon with missing adipose fins are collected and examined for the presence of CWTs.

The Auke Creek stock of coho salmon is one of four Southeast Alaska coho salmon stocks (Berners River in Lynn Canal, Auke Creek near Juneau, Ford Arm Lake near Sitka, and Hugh Smith Lake near Ketchikan) that are being closely monitored through a long-term stock assessment program. These four stocks are considered indicators for the more than 2,000 coho salmon stocks spawning in Southeast Alaska. The indicator stock program was implemented to provide information concerning harvest rates exerted on coho salmon stocks, migration routes used by various stocks, marine survival rates, and other useful fishery statistics. Data collected through this indicator program has provided the information needed to estimate the spawner-recruit relationship for Auke Creek coho salmon for the years 1980-1989 (Clark, Clark, and Shaul 1994). Based upon the spawner-recruit relationship, the coho salmon escapement level for Auke Creek that is predicted to result in maximum sustained yield (MSY) is 341 spawners (90% confidence bounds = 274 to 49) and 90% or more of the MSY is expected to result when spawner levels of from 200 to 500 fish are achieved (Clark, Clark, and Shaul 1994).

Because the annual marine harvest rates for Auke Creek coho salmon have been evaluated since 1980, because this stock is considered to be an indicator stock for other nearby coho salmon stocks, and because coho salmon escapements into Jordan, Montana, Petersen, Steep, and Switzer creeks have been monitored since the early 1980's, the critical information needed to approximate coho salmon BEGs for these five streams is available. Establishment of coho salmon BEGs for Juneau roadside streams has the potential to provide a useful tool for management of the local Juneau area sport fishery. Thus, the objective of this analysis was to estimate or approximate the level of spawner abundance that results in long-term MSY for stocks of coho salmon returning to Jordan, Montana, Petersen, Steep, and Switzer creeks.

AVAILABLE INFORMATION, DATA ANALYSIS, AND ASSUMPTIONS

The marine harvest and marine escapement rates annually estimated for Auke Creek coho salmon were assumed to be representative of marine harvest and marine escapement rates exerted on stocks of coho salmon returning to Jordan, Montana, Petersen, Steep, and Switzer creeks. Information concerning the escapements, marine harvest rates, and marine escapement rates of Auke Creek coho salmon were taken from Clark, Clark, and Shaul (1994) and these data follow:

Year	Escapement Level	Estimated Marine Harvest Rate	Estimated Marine Escapement Rate
1980	698	0.204	0.796
1981	647	0.347	0.653
1982	447	0.409	0.591
1983	694	0.438	0.562
1984	651	0.434	0.566
1985	942	0.442	0.558
1986	453	0.531	0.469
1987	668	0.432	0.568
1988	756	0.365	0.635
1989	502	0.559	0.441
1990	697	0.526	0.474
1991	804	0.298	0.702
1992	1,020	0.224	0.776
1993	859	0.459	0.541
1994	1,253	0.569	0.431

Note: Data for 1994 provided by Scott A. McPherson (personal communication).

Clark, Clark, and Shaul (1994) estimated the spawner-recruit relationship (Ricker curve) for Auke Creek coho salmon after accounting for average marine survival conditions and in so doing developed the following estimates:

Ricker Alpha = 1.92911;
Carrying Capacity = 932;
R^2 = 0.578;
Escapement at Production Maximum = 483;
Biological Escapement Goal (BEG, the escapement producing MSY) = 341;
Bootstrap Estimates of the 90% Confidence Bounds of BEG = 274 to 495;
Escapement Range Predicted to Provide 90% or More of MSY = 200 to 500;
MSY Harvest Rate When BEG is Achieved in the Long-term = 0.706; and,
Harvest Rate Range for the Range of Escapements Predicted to Provide 90% or More of MSY = 0.591 to 0.780.

Peak escapement counts of coho salmon spawning in Jordan, Montana, Petersen, Steep, and Switzer creeks since 1980 were taken from the Integrated Fisheries Data Base (IFDB) located on the VAX computer at the Southeast Regional Office of the Commercial Fisheries Management and Development Division of ADF&G, Douglas, Alaska. Peak counts of spawning coho salmon in the five Juneau roadside streams since 1980 follow:

	Peak Annual Counts of Spawning Coho Salmon				
Year	Jordan Creek	Montana Creek	Petersen Creek	Steep Creek	Switzer Creek
1980	31	-	-	147	7
1981	482	227	219	515	109
1982	368	545	320	232	80
1983	184	636	219	171	77
1984	251	581	189	168	123
1985	72	810	276	186	122
1986	163	60	363	247	54
1987	251	314	204	128	48
1988	215	164	542	155	51
1989	133	566	242	222	78
1990	216	1,711	324	185	82
1991	322	1,415	410	267	227
1992	785	2,512	403	612	93
1993	322	1,352	112	471	94
1994	371	1,829	318	200	107

The escapement data base for coho salmon spawning in Jordan, Montana, Petersen, Steep, and Switzer creeks consists of counts of coho salmon observed by ADF&G staff when walking along the streams. The counts are made at various times during the fall after coho salmon begin to enter the streams to spawn. Each of the counts are specific to a single day; not all spawning fish for the year are observed during any one count because: (1) some fish have not yet arrived; (2) some fish have already died after spawning and have been removed from the stream by scavengers, predators, and high water events; and, (3) some fish are not observed and counted because of overhanging vegetation, deep water, etc.

ADF&G staff used mark-recapture techniques to estimate the number of spawning coho salmon that returned to Steep Creek in 1994. Typical stream surveys of Steep Creek to enumerate spawning coho salmon were also conducted. Results of this research indicated that the portion of the total coho salmon escapement counted in Steep creek during the peak 1994 survey was 0.22 (200 coho salmon counted during the peak survey and 915 coho salmon estimated in the spawning population; Scott A. McPherson, personal communication). As a result of this research, I expanded the peak spawner counts for Steep Creek by a factor of five for the years 1980-1994. Further, I quizzed ADF&G staff that conduct the coho salmon escapement counts to seek their professional judgements concerning the likely relationships between peak spawner counts and total escapements of coho salmon into the other four streams. These professional judgements were used to make assumptions concerning expansion of peak counts into estimates of total escapements as follows:

Stream	Portion of Total Escapement Represented by Peak Spawner Count	Mathematical Adjustment of Peak Spawner Count
Jordan Creek	20%	Peak Count * 5.0
Montana Creek	20%	Peak Count * 5.0
Petersen Creek	25%	Peak Count * 4.0
Steep Creek	20%	Peak Count * 5.0
Switzer Creek	40%	Peak Count * 2.5

Auke Creek coho salmon are harvested only in marine waters. However, some of the other Juneau roadside coho salmon stocks are exploited by sport fishermen in freshwater in addition to marine exploitation. The Statewide Harvest Surveys (SWHS) reported by Mills (1981-1993) provide collective estimates of the harvest of coho salmon in streams crossed by the Juneau road system along the mainland from Dupont Point to Echo Cove, and on Douglas Island. Sport fishing in Jordan, Steep, and Switzer creeks is closed; however, significant sport fishing for coho salmon occurs in Montana, Petersen, and Cowee creeks during the fall. ADF&G staff familiar with local Juneau sport fisheries were quizzed to seek their professional judgements concerning the likely portion of the total freshwater harvest of coho salmon reported by Mills (1980-1993) that would be attributable to Montana, Petersen, and Cowee creeks. These professional judgements were used to make assumptions concerning freshwater harvests of coho salmon in these three streams and these assumptions and the resulting estimates of harvest in freshwater are summarized below:

	Juneau Road System	Estimated Harvest of Coho Salmon in Freshwater					
	Freshwater Coho Harvest	Montana Creek		Petersen Creek		Cowee Creek	
Year	Mills - SWHS	Percent	Number	Percent	Number	Percent	Number
1980	86	25%	22	25%	22	50%	43
1981	97	25%	24	25%	24	50%	49
1982	136	25%	34	25%	34	50%	68
1983	934	25%	234	25%	234	50%	467
1984	229	25%	57	25%	57	50%	115
1985	74	25%	19	25%	19	50%	37
1986	201	25%	50	25%	50	50%	101
1987	282	25%	71	25%	71	50%	141
1988	1,218	25%	305	25%	305	50%	609
1989	272	25%	68	25%	68	50%	136
1990	434	25%	109	25%	109	50%	217
1991	795	25%	199	25%	199	50%	398
1992	1,020	25%	255	25%	255	50%	510
1993	750	25%	188	25%	188	50%	375
1994	750	25%	188	25%	188	50%	375

Note: 1993 and 1994 SWHS estimates not yet available; 750 = average value for 1990-1992; and, this value was used for both 1993 and 1994.

Age composition of coho salmon escapements in Jordan, Montana, Petersen, Steep, and Switzer creeks have not been monitored. The exception to this was the research conducted at Steep Creek in 1994. While conducting the mark-recapture experiment for Steep Creek coho salmon in 1994, fish were scale sampled and scales were read to estimate age composition of the spawning population. Results were as follows (Scott A. McPherson, personal communication):

(1) 40.0% of the escapement was composed of age 3 fish;
(2) 55.4% of the escapement was composed of age 4 fish; and,
(3) 4.6% of the escapement was composed of age 5 fish.

I elected to use the assumption that the returns of coho salmon to Jordan, Montana, Petersen, Steep, and Switzer creeks were composed of 40% age 3 fish and 60% age 4 fish in order to develop brood tables and spawner-recruit curves.

Paired data sets consisting of estimated spawner abundance and resulting total returns were used to develop spawner-recruit relationships (Ricker curves) for the coho salmon populations of Jordan, Montana, Petersen, Steep, and Switzer creeks. As noted above, annual spawner abundance for the Jordan Creek, Montana Creek, and Steep Creek stocks of coho salmon were estimated by multiplying the annual peak escapement counts by a factor of five; whereas, annual abundance for the Petersen Creek stock of coho salmon was estimated by multiplying peak counts by a factor of four and the Switzer Creek stock of coho salmon was estimated by multiplying peak counts by a factor of 2.5. Annual inshore or freshwater total returns were estimated by adding the estimated total escapements to the freshwater harvests documented by Mills (1981-1993) after applying the assumed freshwater harvest distribution of 25% Montana Creek, 25% Petersen Creek, and 50% Cowee Creek. Annual total returns of coho salmon to Jordan, Montana, Petersen, Steep, and Switzer creeks were estimated by dividing the estimated annual freshwater return of coho salmon to each stream by the corresponding annual Auke Creek coho salmon escapement rate to account for marine harvests. Estimated total spawning escapements in year *i* were aligned with 40% of estimated total returns in year *i+3* added to 60% of estimated total returns in year *i+4* for each of the five populations. Once the paired data sets for each of the five coho salmon stocks were constructed, they were used to develop spawner-recruit relationships by fitting the paired data sets with the following model:

$$R = Se^{a(1-(S/Pm))} \qquad \text{(EQ 1)}$$

where: R = predicted total return (recruitment);
S = spawning escapement level;
e = natural logarithm;
a = intercept of the regression (Ricker's alpha); and,
Pm = carrying capacity as calculated by the regression.

This model, commonly referred to as a Ricker recruitment curve, (Ricker 1975), has two parameters to estimate, *a* and *Pm*. I assumed the errors were multiplicative (as is common when variables are counts), resulting in the log-transformed equation:

$$LN(R/S) = a-(a/Pm)S + \text{error}. \qquad \text{(EQ 2)}$$

Linear regression procedures provided estimates of the intercept (*a*) and the slope (*a/Pm*) of the equation. The estimated number of spawners (biological escapement goal or BEG) that produce the maximum harvestable surplus (MSY) was estimated by iteratively solving the equation:

$$S = (Pm/a) * (1-exp\{-a[1-S/Pm]\}). \qquad \text{(EQ 3)}$$

Once the estimated number of spawners that produce the maximum harvestable surplus was estimated (BEG), the range of escapements that produce 90% or more of MSY was also estimated by iteratively solving EQ 3.

Although the primary analysis was development of spawner-recruit relationships with corresponding estimates of the escapements that produce MSY and 90% or

more of MSY (hereafter referred to as the **Spawner-Recruit Analysis**), I also conducted other analysis.

Maximum sustainable harvests for the Auke Creek stock of coho salmon are predicted to occur when escapements of 341 spawners occur and 90% or more of MSY is predicted to occur when escapements range from 200-500 spawners (Clark, Clark, and Shaul, 1994). These yields from the Auke Creek stock of coho salmon occur for MSY at a harvest rate of 0.71 and occur for 90% or more of MSY at harvest rates that range from 0.59 to 0.78 (Clark, Clark, and Shaul, 1994). I used the spawner-recruit curves calculated for the five stocks of coho salmon to determine escapement levels that correspond, on average, to harvest rates of 0.59, 0.71, and 0.78. If production potential for these five stocks of coho salmon are similar to the Auke Creek stock of coho salmon, I reasoned that escapement levels calculated in this manner would reflect escapements likely to approach MSY. This approach to determining escapements that likely approach MSY is hereafter referred to as the **Exploitation Rate Analysis**.

A third approach to determining escapement levels for the coho salmon stocks of Jordan, Montana, Petersen, Steep, and Switzer creeks that may result in MSY is termed the **Proportional Escapements Analysis**. Escapements of coho salmon into Auke Creek since 1980 have typically exceeded the range estimated to produce MSY. Two (13%) of the annual Auke Creek coho salmon escapements since 1980 have been within the 200-500 spawner range estimated to produce 90% or more of MSY; while, 13 (87%) of the escapements have exceeded the 200-500 spawner range. All of the coho salmon escapements since 1990 (the last five years) into Auke Creek have exceeded the range of escapements estimated to produce 90% or more of MSY. Escapements of coho salmon into Auke Creek since 1980 have averaged 739 spawners and the median escapement during this time period was 697 spawners. The range of escapements expected to provide 90% or more of MSY for Auke Creek coho salmon (200-500 spawners) range from 0.27 to 0.68 of the average escapement and range from 0.29 to 0.72 of the median escapement. Average and median escapements of coho salmon into Jordan, Montana, Petersen, Steep, and Switzer creeks were calculated. These average escapement levels were multiplied by 0.27 and 0.68 to estimate escapements that would be proportional to the average range of Auke Creek coho salmon escapements that are within 90% of MSY. Similarly, the median escapement levels for Jordan, Montana, Petersen, Steep, and Switzer creeks were multiplied by 0.29 and 0.72 to estimate escapements that would be proportional to the median range of Auke Creek coho salmon escapements that are within 90% of MSY. The ranges for the averages and medians were compared and the lowest and highest escapements from the average and median calculations were selected for each of the five stocks to represent escapements expected to produce 90% or more of MSY under the **Proportional Escapements Analysis**.

A fourth approach to determining escapement levels for the coho salmon stocks of Jordan, Montana, Petersen, Steep, and Switzer creeks that may result in MSY is termed the **Rearing Area Analysis**. Zillges (1977) presented an approach to setting escapement goals for coho salmon based upon stream rearing area. For streams less than 6 yards (5.5 m) in width, Zillges (1977) suggested that optimal smolt density was 0.42 smolts per square yard of rearing area. He goes on to suggest that once rearing area of a stream is calculated in square

yards, the optimal factor of 0.42 smolt per square yard (0.35 smolt per m^2) be multiplied by the rearing area and the product be divided by 100 (a conversion factor to take into account the number of females needed to produce the smolt) and the result be multiplied by 2 (to take into account a 1:1 ratio of males to females in the escapement). The end result of these calculations is the simple multiplication of the stream rearing area (in square yards) by a factor of 0.0084 to estimate the biological escapement goal for coho salmon. Zillges (1977) suggests that for streams greater in width than 6 yards, that stream distance (in yards) be multiplied by a factor of 2.5 to determine rearing area because streams wider than 6 yards do not necessarily provide proportionally larger effective rearing areas for coho salmon. The methodology suggested by Zillges (1977) was applied to Jordan, Montana, Petersen, Steep, and Switzer creeks after rearing areas were approximated. Available information concerning the rearing area in Jordan, Montana, Petersen, Steep, and Switzer creeks was reviewed by Sport Fish Division staff familiar with these streams and the results of this review follow:

Stream	Type[a] Analysis	Approximate Width	Approximate Length	Measurements Used Width	Measurements Used Length	Calculated Rearing Area
Jordan	1	6-12 feet	3 miles	3 yds	5,280 yds	15,840 yd^2
Montana	1	25 feet	8 miles	8 yds	14,080 yds	112,640 yd^2
Montana	2	25 feet	8 miles	2.5 yds	14,080 yds	35,200 yd^2
Petersen	1	15 feet	3 miles	5 yds	5,280 yds	26,400 yd^2
Steep	1	6-12 feet	1 mile	3 yds	1,760 yds	5,280 yd^2
Switzer	1	4-6 feet	1 mile	2 yds	1,760 yds	3,520 yd^2

[a] Type 1 analysis calculates rearing area by multiplying stream length by stream width. Type 2 analysis calculates rearing area by multiplying the stream length by a factor of 2.5 for streams in excess of 6 yards in width.

RESULTS AND DISCUSSION

Jordan Creek Coho Salmon

Since 1980, coho salmon index escapements in Jordan Creek have ranged from 31 to 785 fish with the range of escapements included in the **spawner-recruit analysis** ranging from 31 to 482 index spawners, almost a 16-fold difference. The spawner-recruit relationship (Figure 1) developed for Jordan Creek coho salmon has a high R^2 value (R^2 = 0.867). The BEG (modeled escapement resulting in MSY) for Jordan Creek coho salmon was estimated with the **spawner-recruit analysis** to be about 600 fish or an index value of about 120 spawners counted during the peak survey (Table 1; Part 1b). The escapements estimated to result in 90% or more of MSY from the Jordan Creek stock of coho salmon with the **spawner-recruit analysis** ranged from about 350 to 900 spawners or index values ranging from about 70 to 180 spawners counted during peak surveys (Table 1; Part 1b). The **spawner-recruit analysis** indicates that coho salmon escapements into Jordan Creek typically exceed the range of escapements expected to result in 90% of more of MSY (73% of the years since 1980; see Table 1; Part 1c).

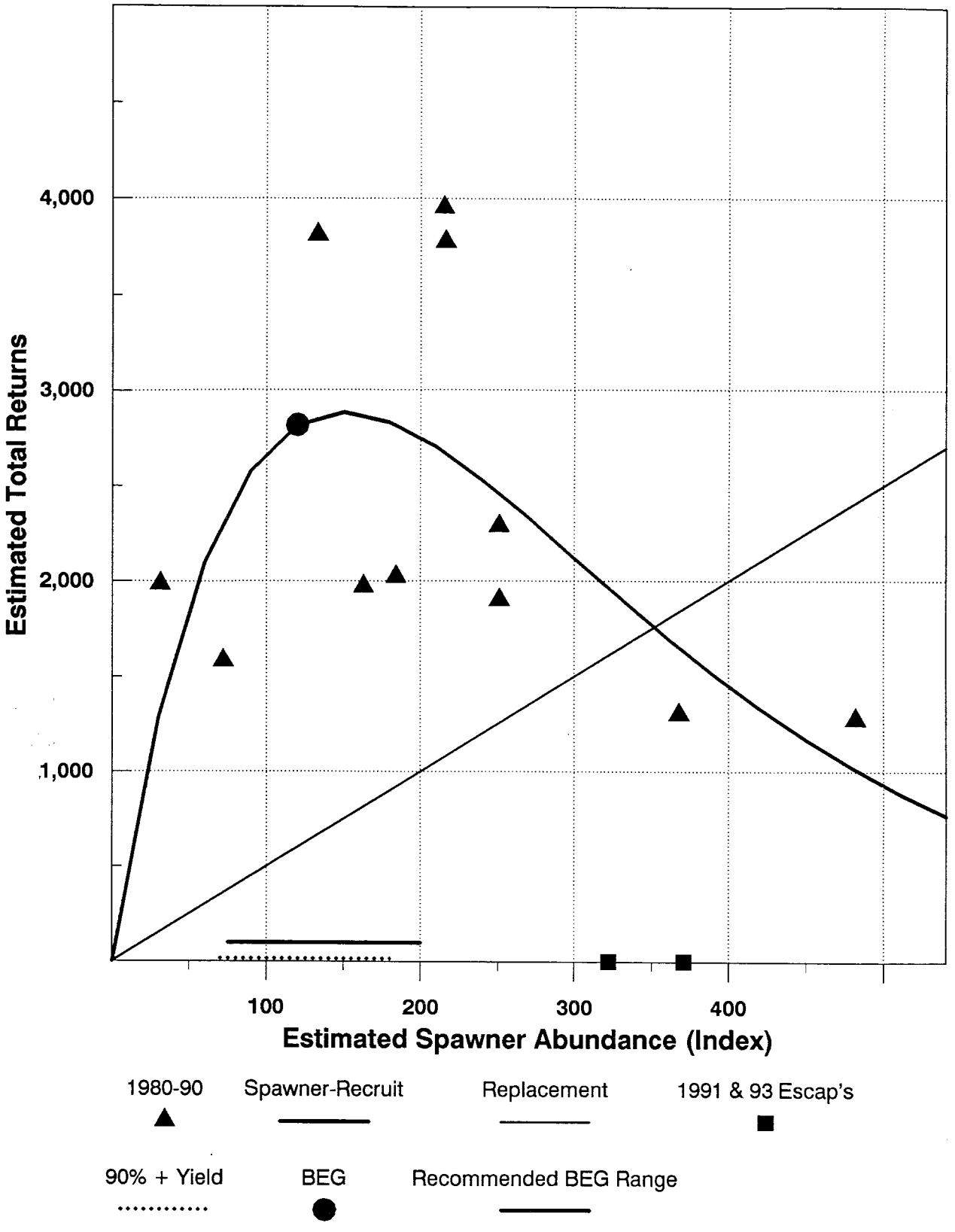

Figure 1. Spawner-recruit relationship for Jordan Creek coho salmon.

Table 1. BEG calculations for coho salmon stocks returning to monitored Juneau area roadside streams based upon the **Spawner-Recruit Analysis**.

PART 1a: Assumptions Associated With Spawner-Recruit Analysis:

Stream	Annual Marine Harvest Rates	Age Composition	Peak Esc. Count Expansion	Juno. Road F.W. Harvest (Mills Rept)
Auke Creek	CWT Monitored Since 1980	Monitored	Wier	None
Jordan Creek	Auke Cr. Used as Proxy	40%-3; 60%-4	Esc.*5.0	None
Montana Creek	Auke Cr. Used as Proxy	40%-3; 60%-4	Esc.*5.0	25%/year
Petersen Creek	Auke Cr. Used as Proxy	40%-3; 60%-4	Esc.*4.0	25%/year
Steep Creek	Auke Cr. Used as Proxy	40%-3; 60%-4	Esc.*5.0	None
Switzer Creek	Auke Cr. Used as Proxy	40%-3; 60%-4	Esc.*2.5	None

PART 1b: BEG's Based Upon Spawner-Recruit (Ricker) Curves:

	Return/Spawner Stats.					
			Replac.	BEG	Expanded (Index) 90% Max. Harvest Bounds	
Stream	R^2	Ricker Alpha.	Value (Index)	(Index) Escapements	Lower	Upper
Auke Creek	0.578	1.929	930	340 (340)	200 (200)	500 (500)
Jordan Creek	0.867	2.347	350	600 (120)	350 (70)	900 (180)
Montana Creek	0.305	2.193	1,300	2,250 (450)	1,250 (250)	3,250 (650)
Petersen Creek	0.658	1.572	590	920 (230)	600 (150)	1,280 (320)
Steep Creek	0.591	1.569	410	800 (160)	500 (100)	1,150 (230)
Switzer Creek	0.800	2.904	112	85 (34)	60 (24)	120 (48)
Totals	-	-		4,995	2,960	7,200

PART 1c: Number And Percentage Of Times That Escapement Was Within BEG Range:

Coho Salmon Stock	MSY Escapement Range	Number of Years Escapement Monitored	No. of Yrs. Escap. Was: Below Range: No.	%	Within Range: No.	%	Above Range: No.	%	No. of Years Since 1989 That Escapement Was Within Range: No.	%
Auke Creek	200 - 500	15	0	0%	2	14%	13	86%	0	0%
Jordan Creek	70 - 180	15	1	7%	3	20%	11	73%	0	0%
Montana Creek	250 - 650	14	3	21%	5	36%	6	43%	0	0%
Petersen Creek	150 - 320	14	1	7%	8	57%	5	36%	2	40%
Steep Creek	100 - 230	15	0	0%	9	60%	6	40%	2	40%
Switzer Creek	24 - 48	15	1	7%	1	7%	13	86%	0	0%
Totals	-	88	6	7%	28	32%	54	61%	4	13%

The **exploitation rate analysis** indicates that MSY would be achieved with escapements that are about 25% than the BEG indicated with the **spawner-recruit analysis**. Indicated BEG is about 800 spawners or an index peak count of about 160 spawners, (Table 2; Part 2b). This is because the harvest rate at BEG in the **spawner-recruit analysis** is 79% or about 8% higher than the harvest rate calculated for the Auke Creek stock of coho salmon (71%). Either the **spawner-recruit analysis** provides an underestimate of the BEG or the coho salmon production potential of Jordan Creek is higher than is the case for Auke Creek. On the other hand, the harvest rates at MSY for the coho salmon stocks of the Berners River, Ford Arm Lake and Hugh Smith Lake are 81.4%, 68.1%, and 81.0%, respectively, according to Clark, Clark, and Shaul (1994) indicating that coho salmon production potential varies by system in Southeast Alaska. Further, the optimum harvest rate value for Jordan Creek obtained with the **spawner-recruit analysis** of 79% is close to the calculated values of 81.4% and 81.0% for the Berners River and Hugh Smith Lake stocks of coho salmon, respectively. The **exploitation rate analysis** indicates that the escapements of coho salmon into Jordan Creek typically exceed the range of escapements expected to result in MSY (53% of the years since 1980; see Table 2; Part 2c).

The **proportional escapements analysis** indicates that the escapements of coho salmon into Jordan Creek typically exceed the range of escapements expected to result in MSY (67% of the years since 1980; see Table 3; Part 3c). The **proportional escapements analysis** indicates that 90% or more of MSY for the Jordan Creek stock of coho salmon would be achieved with index peak escapement counts ranging from 70 to 190 spawners (Table 3; Part 3b). Although this range of index counts is reasonably similar to results obtained under both the **spawner-recruit analysis** and the **exploitation rate analysis**, caution should be used with results from this analysis. The **proportional escapements analysis** would be most appropriate when high annual correlations occur between coho salmon escapement levels in Auke Creek and the stream of interest; in this case, Jordan Creek, the correlation in annual coho salmon escapement counts is only 0.355 (Figure 2).

The **rearing area analysis** indicates that the BEG for coho salmon spawning in Jordan Creek is 133 spawners or an index count of only 27 spawners during a peak survey (Table 4). This value is well below the range of escapements predicted to provide 90% of more of MSY with the **spawner-recruit analysis**, the **proportional escapements analysis**, and **exploitation rate analysis**. The **rearing area analysis** suggests BEGs for all five stocks of coho salmon returning to Juneau roadside streams that are substantially below BEGs suggested by other methods used in this report (Table 5). This consistent result can be explained in two alternate ways: (1) expansions of peak counts used to estimate total escapements of coho salmon were too high; or, (2) density of coho salmon spawners resulting in MSY in Southeast Alaska is substantially higher than is the case in Washington. I suspect the second of the two alternative explanations is the most appropriate.

My recommendation is to establish a BEG range of 75 to 200 coho salmon counted during a peak survey of Jordan Creek. I recommend using 150 coho salmon counted during a peak survey as the point value for the BEG for Jordan Creek coho salmon. My recommended BEG range for peak survey counts encompasses the results of all three analyses (Table 5) which were directed at establishing an

Table 2. BEG calculations for coho salmon stocks returning to monitored Juneau area roadside streams based upon the **Exploitation Rate Analysis**.

PART 2a: Assumptions Associated With Setting BEG's for Other Five Systems Based Upon Ricker Curves and Escapement/Exploitation Rates Being the Same as Auke Creek at MSY:

Stream	Assumptions Associated With Construction of Ricker Curves (annual harvest rates, age composition, peak escapement count expansions, and Juneau roadside freshwater harvests)	Optimal Harvest Rate	Harvest Rate for 90% MSY Bounds: Lower	Upper
Auke Creek	Not Applicable	71%	78%	59%
Jordan Creek	Same as those listed in Part 1a	71%	78%	59%
Montana Creek	Same as those listed in Part 1a	71%	78%	59%
Petersen Creek	Same as those listed in Part 1a	71%	78%	59%
Steep Creek	Same as those listed in Part 1a	71%	78%	59%
Switzer Creek	Same as those listed in Part 1a	71%	78%	59%

PART 2b: BEG's Based Upon Spawner-Recruit Curves and Auke Creek Harvest Rates @ MSY:

Stream	BEG Equivalent to Auke Creek Coho Escapement @ BEG Escap.	Harv. Rate	BEG Range Equivalent to Auke Creek Coho Escapement @ 90% of MSY Lower Bound: Escap.	Harv. Rate	Upper Bound: Escap.	Harv. Rate
Auke Creek	340	71%	200	78%	500	59%
Jordan Creek	800 (160)	71%	600 (120)	78%	1,100 (220)	59%
Montana Creek	2,750 (550)	71%	2,000 (400)	78%	4,000 (800)	59%
Petersen Creek	480 (120)	71%	80 (20)	78%	1,000 (250)	59%
Steep Creek	450 (90)	71%	100 (20)	78%	900 (180)	59%
Switzer Creek	160 (64)	71%	140 (56)	78%	200 (80)	59%
Totals	4,980	71%	3,120	78%	7,700	59%

PART 2c: Number And Percentage Of Times That Escapement Was Within BEG Range:

Coho Salmon Stock	MSY Escapement Range	Number of Years Escapement Monitored	No. of Yrs. Escap. Was: Below Range: No.	%	Within Range: No.	%	Above Range: No.	%	No. of Years Since 1989 That Escapement Was Within Range: No.	%
Auke Creek	200 - 500	15	0	0%	2	14%	13	86%	0	0%
Jordan Creek	120 - 210	15	2	14%	5	33%	8	53%	1	20%
Montana Creek	400 - 510	14	4	29%	4	29%	6	42%	0	0%
Petersen Creek	30 - 270	14	0	0%	6	43%	8	57%	1	20%
Steep Creek	15 - 165	15	0	0%	5	33%	10	67%	0	0%
Switzer Creek	53 - 75	15	4	27%	3	20%	8	53%	0	0%
Totals	-	88	10	11%	25	28%	53	61%	2	7%

Table 3. BEG calculations for coho salmon stocks returning to monitored Juneau area roadside streams based upon the **Proportional Escapements Analysis**.

PART 3a: Assumptions Associated With Setting BEG's for Other Five Systems Based Upon Escapements Proportional to Auke Creek MSY:

Stream	MSY Calculation and Assumption
Auke Creek	MSY Range Determined from Spawner-Recruit (Ricker) Curve
Jordan Creek	MSY Range for 1980-94 Escap's is Prop. to Auke Creek @ MSY
Montana Creek	MSY Range for 1981-94 Escap's is Prop. to Auke Creek @ MSY
Petersen Creek	MSY Range for 1981-94 Escap's is Prop. to Auke Creek @ MSY
Steep Creek	MSY Range for 1980-94 Escap's is Prop. to Auke Creek @ MSY
Switzer Creek	MSY Range for 1980-94 Escap's is Prop. to Auke Creek @ MSY

PART 3b: BEG's Based Upon Proportional Escapements as Compared to Auke Creek MSY:

	1980-1994 Average	1980-1994 Median	Average (0.27 to 0.68)		Median (0.29 to 0.72)		Avg.-Med. Combined	
Stream	Escapement	Escapement	Low	High	Low	High	Low	High
Auke Creek	739	697	200	500	200	500	200	500
Jordan Creek	278	251	75	189	73	181	70	190
Montana Creek	909	609	245	618	177	438	180	620
Petersen Creek	296	297	80	201	86	214	80	210
Steep Creek	260	200	70	177	58	144	60	180
Switzer Creek	96	82	26	65	24	59	20	70

PART 3c: Number And Percentage Of Times That Escapement Was Within BEG Range:

Coho Salmon Stock	MSY Escapement Range	Number of Years Escapement Monitored	No. of Yrs. Escap. Was: Below Range: No.	%	Within Range: No.	%	Above Range: No.	%	No. of Years Since 1989 That Escapement Was Within Range: No.	%
Auke Creek	200 - 500	15	0	0%	2	14%	13	86%	0	0%
Jordan Creek	70 - 200	15	1	7%	4	26%	10	67%	0	0%
Montana Creek	170 - 600	14	2	14%	5	36%	7	50%	0	0%
Petersen Creek	70 - 210	14	0	0%	3	21%	11	79%	1	20%
Steep Creek	60 - 190	15	0	0%	5	33%	10	67%	0	0%
Switzer Creek	20 - 60	15	1	7%	3	20%	11	73%	0	0%
Totals	-	88	4	5%	22	25%	62	70%	1	3%

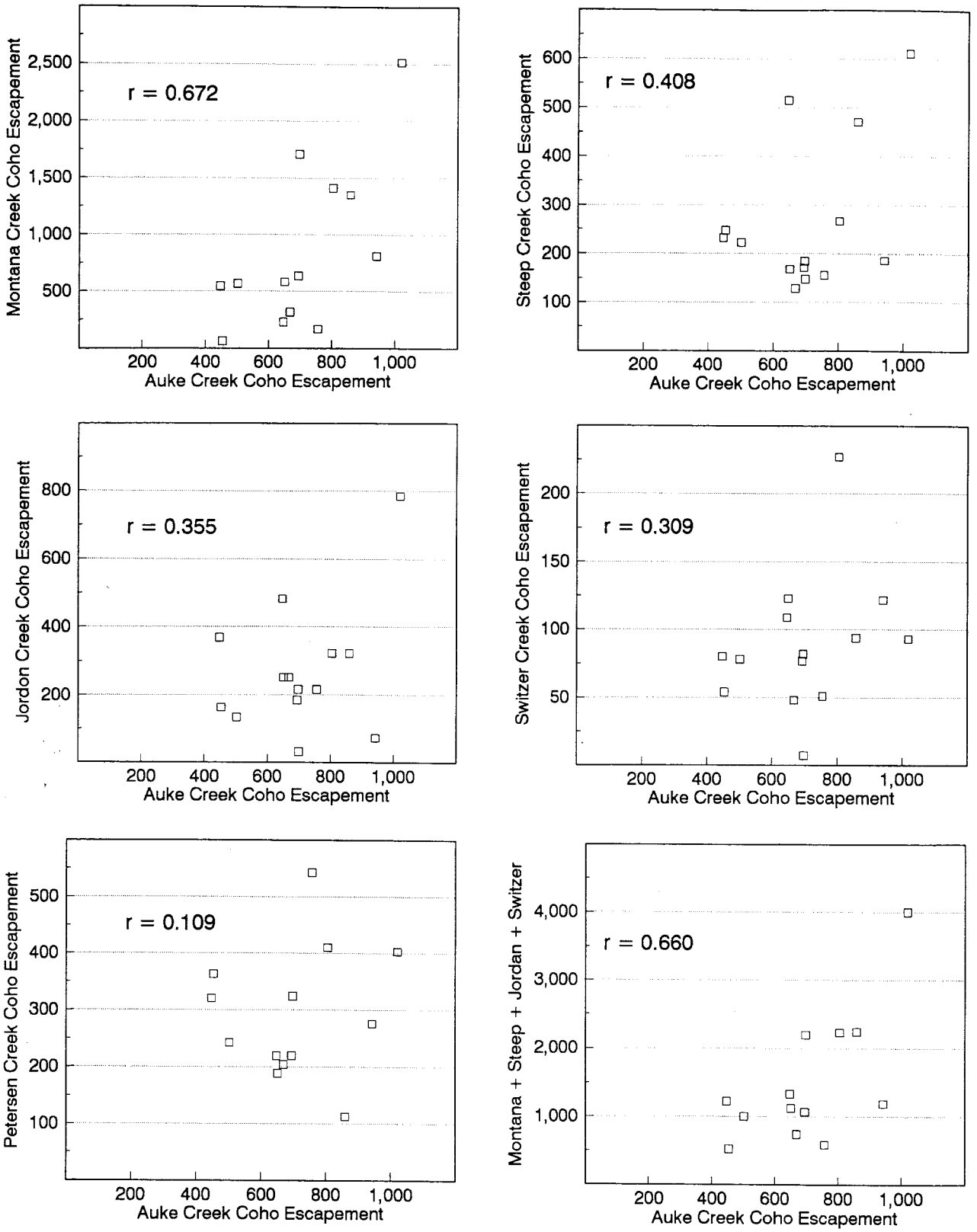

Figure 2. Correlations between the Auke Creek coho escapement and the coho escapements in Montana, Steep, Jordan, Switzer, and Petersen creeks.

Table 4. Escapement goal calculations for coho salmon stocks returning to monitored Juneau area roadside streams based upon the **Rearing Area Analysis**.

Stream	Type[1] Analysis	Rearing Area in Square Yards	Multiplication Factor	Estimated Optimal Coho Salmon Escapement Goal Expanded	Index
Jordan	1	15,840 yd^2	0.0084	133	27
Montana	1	112,640 yd^2	0.0084	946	189
Montana	2	35,200 yd^2	0.0084	296	59
			Averages:	621	124
Petersen	1	26,400 yd^2	0.0084	222	56
Steep	1	5,280 yd^2	0.0084	44	9
Switzer	1	3,520 yd^2	0.0084	30	12

[1] Type 1 analysis calculates rearing area by multiplying stream length by stream width. Type 2 analysis calculates rearing area by multiplying the stream length by a factor of 2.5 for streams in excess of 6 yards in width.

Table 5. Summary of BEG calculations (in index counts) for coho salmon stocks returning to monitored Juneau area roadside streams using four alternate approaches.

	Potential MSY Ranges for Monitored Juneau Roadside Coho Streams						
	Sp/ Rec Anal		Harv Rt Anal		Prop Esc Anal		Rear Area Anal
Stream	Low	High	Low	High	Low	High	Optimal
Auke Creek	200	500	200	500	200	500	-
Jordan Creek	70	180	120	220	70	190	27
Montana Creek	250	650	400	800	180	620	124
Petersen Creek	150	320	20	250	80	210	56
Steep Creek	100	230	20	180	60	180	9
Switzer Creek	24	48	56	80	20	70	12

escapement goal range that is likely to produce 90% or more of MSY from the Jordan Creek stock of coho salmon; but is substantially higher than the BEG point value indicated with the **rearing area analysis**.

Montana Creek Coho Salmon

Since 1981 coho salmon index escapements in Montana Creek have ranged from 60 to 2,512 fish with the range of escapements included in the **spawner-recruit analysis** ranging from 60 to 1,711 index spawners, almost a 30-fold difference. The spawner-recruit relationship (Figure 3) developed for Montana Creek coho salmon has a low R^2 value (R^2 = 0.305). The BEG for Montana Creek coho salmon as estimated with the **spawner-recruit analysis** was about 2,250 fish or an index value of about 450 spawners counted during the peak survey (Table 1; Part 1b). The escapements estimated to result in 90% or more of MSY from the Montana Creek stock of coho salmon with the **spawner-recruit analysis** ranged from about 1,250 to 3,250 total spawners or from about 250 to 650 spawners counted during peak surveys (Table 1; Part 1b). The **spawner-recruit analysis** indicates that coho salmon escapements into Montana Creek often exceed the range of escapements expected to result in 90% or more of MSY (43% of the years since 1981 see Table 1; Part 1c).

The **exploitation rate analysis** indicates that MSY would be achieved with larger escapements than the range indicated with the **spawner-recruit analysis**. The indicated BEG is about 2,750 spawners or an index peak count of about 550 spawners, approximately a 25% higher escapement level than the **spawner-recruit analysis** BEG (Table 2; Part 2b). This is because the harvest rate at BEG in the **spawner-recruit analysis** is 76% or about 5% higher than the optimum harvest rate calculated for the Auke Creek stock of coho salmon (71%). Either the **spawner-recruit analysis** provides an underestimate of the BEG or the coho salmon production potential of Montana Creek is higher than is the case for Auke Creek. Optimum harvest rates at BEG for the Berners River and Hugh Smith Lake stocks of coho salmon were found to be 81.4% and 81.0%, respectively (Clark, Clark, and Shaul 1994). Thus, the indicated rate of 76% for the Montana Creek stock of coho salmon according to the **spawner-recruit analysis** is similar to other studied coho salmon stocks in Southeast Alaska. The **exploitation rate analysis** indicates that the escapements of coho salmon into Montana Creek often exceed the range of escapements expected to result in MSY (42% of the years since 1981 see Table 2; Part 2c).

The **proportional escapements analysis** indicates that the escapements of coho salmon into Montana Creek often exceed the range of escapements expected to result in MSY (50% of the years since 1981 see Table 3; Part 3c). The **proportional escapements analysis** indicates that 90% or more of MSY for the Montana Creek stock of coho salmon would be achieved with index peak escapement counts ranging from about 180 to 620 spawners (Table 3; Part 3b). Although this range of BEG index counts is similar to the ranges obtained under the **spawner-recruit analysis** and the **exploitation rate analysis**, caution should be used with results from this analysis because the annual correlation between coho salmon escapement counts in Auke Creek and in Montana Creek is only 0.672 (Figure 2).

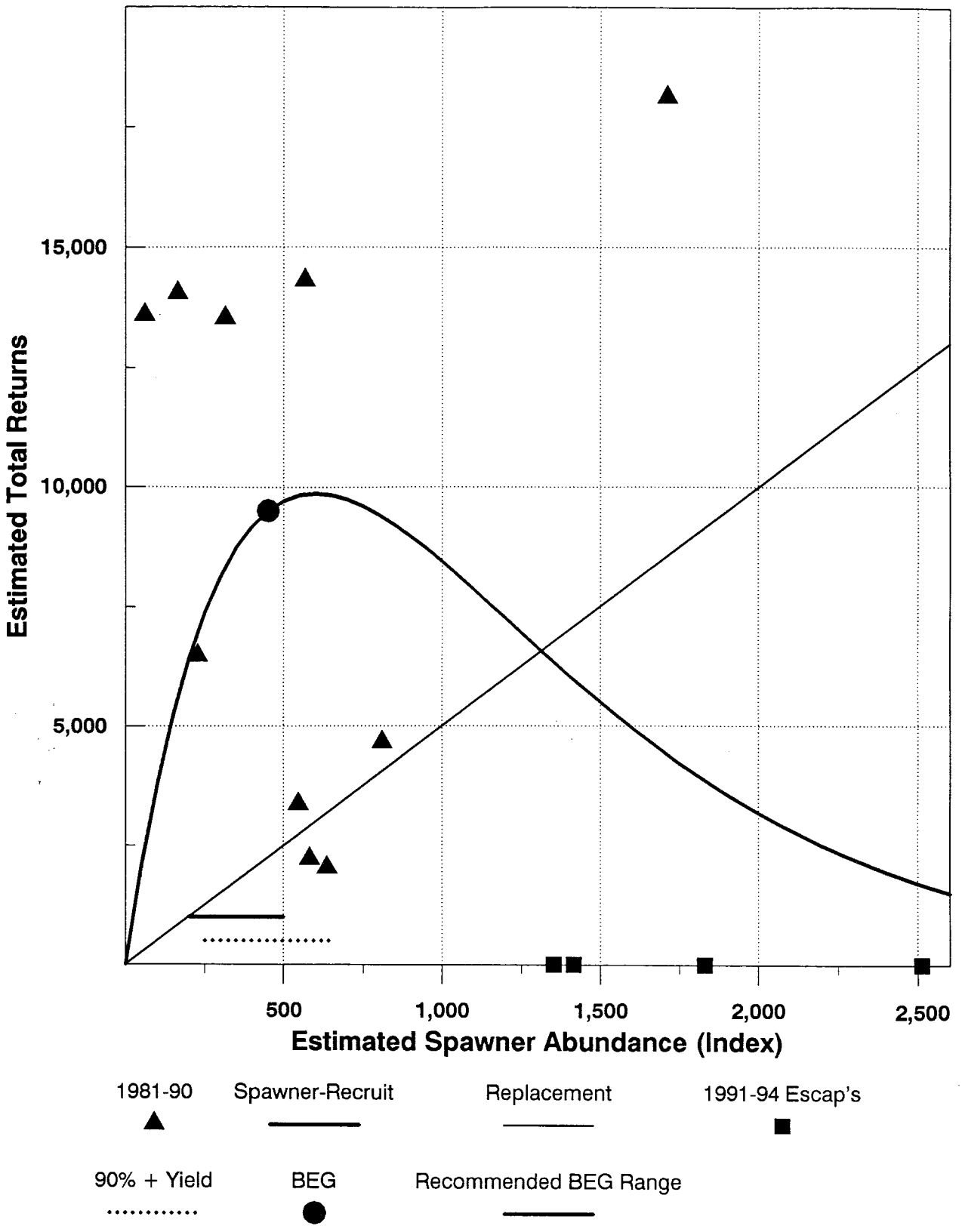

Figure 3. Spawner-recruit relationship for Montana Creek coho salmon.

The **rearing area analysis** using the type 1 approach indicates that the BEG for coho salmon spawning in Montana Creek is 946 spawners or an index count of 189 spawners during a peak survey (Table 4). Use of the type 2 approach for Montana Creek (Montana Creek is believed to average more than 6 yards wide), indicates that the BEG for coho salmon spawning in Montana Creek is 296 spawners or an index count of 59 spawners during a peak survey (Table 4). Because Montana Creek is about 25 feet wide, just slightly wider than the 6 yard criteria, I believe the best estimate based upon the **rearing area analysis** approach would be to average the two types of estimates which results in a BEG of 621 coho salmon spawners in Montana Creek or a peak index count of 124 spawners. This BEG value of 124 index spawners is well below the range of escapements predicted to provide 90% of more of MSY with the **spawner-recruit analysis**, the **proportional escapements analysis**, and the **exploitation rate analysis** as is the case for the other four coho salmon stocks returning to Juneau roadside streams.

My recommendation is to establish a BEG range of 200 to 500 coho salmon counted during a peak survey of Montana Creek. I suggest using 450 coho salmon counted during a peak survey as the point value for the BEG for Montana Creek coho salmon.

Petersen Creek Coho Salmon

Since 1981 coho salmon index escapements in Petersen Creek have ranged from 112 to 542 fish with the range of escapements included in the **spawner-recruit analysis** ranging from 189 to 542 index spawners, almost a 3-fold difference. The spawner-recruit relationship (Figure 4) developed for Petersen Creek coho salmon has a moderate R^2 value (R^2 = 0.658). The BEG for Petersen Creek coho salmon estimated with the **spawner-recruit analysis** was about 920 fish or an index value of about 230 spawners counted during the peak survey (Table 1; Part 1b). The escapements estimated to result in 90% or more of MSY from the Petersen Creek stock of coho salmon with the **spawner-recruit analysis** ranged from about 600 to 1,280 total spawners or index values ranging from about 150 to 320 spawners counted during peak surveys (Table 1; Part 1b). The **spawner-recruit analysis** indicates that coho salmon escapements into Petersen Creek are often in the range of escapements expected to result in 90% of more of MSY (57% of the years since 1981; see Table 1; Part 1c); and that when escapements are not in the indicated BEG range, they exceed the BEG range (36% of the years since 1981 see Table 1; Part 1c).

The **exploitation rate analysis** indicates that MSY would be achieved with lower escapements than the range indicated with the **spawner-recruit analysis**. The indicated BEG is about 480 spawners or an index peak count of about 120 spawners; approximately a 50% lower escapement level than the BEG indicated with the **spawner-recruit analysis** (Table 2; Part 2b). This is because the optimum harvest rate at BEG in the **spawner-recruit analysis** is 61% or about 10% lower than the harvest rate calculated for the Auke Creek stock of coho salmon (71%). Either the **spawner-recruit analysis** provides an overestimate of BEG or the coho salmon production potential of Petersen Creek is lower than is the case for Auke Creek. The range of harvest rates at BEG for other Southeast Alaska coho salmon stocks (Clark, Clark, and Shaul 1994) ranges from

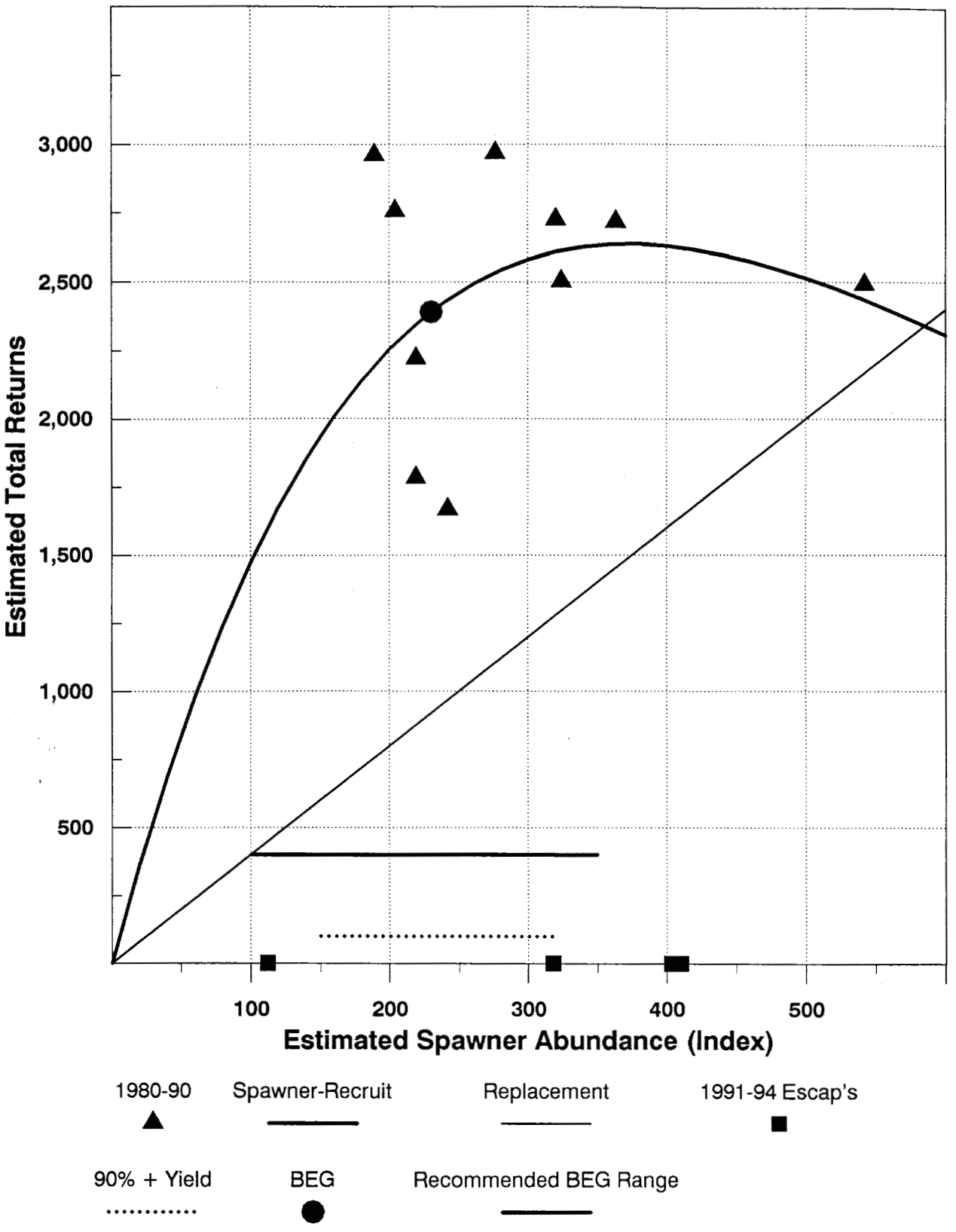

Figure 4. Spawner-recruit relationship for Petersen Creek coho salmon.

68.1% for coho salmon returning to Ford Arm Lake to 81.4% for coho salmon returning to the Berners River; the statistic estimated for Petersen Creek falls below this range. I suspect that optimum harvest rate at BEG for Petersen Creek coho salmon is somewhat higher than the **spawner-recruit analysis** indicates because the range of escapements included in the **spawner-recruit analysis** only varies about 3-fold. The **exploitation rate analysis** indicates that the escapements of coho salmon into Petersen Creek typically exceed the range of escapements expected to result in 90% or more of MSY (57% of the years since 1981 see Table 2; Part 2c); all other escapements of coho salmon into Petersen Creek fall within the estimated BEG range (43% of the years since 1981 see Table 2; Part 2c).

The **proportional escapements analysis** indicates that the escapements of coho salmon into Petersen Creek typically exceed the range of escapements expected to result in MSY (79% of the years since 1981 see Table 3; Part 3c). The **proportional escapements analysis** indicates that 90% or more of MSY for the Petersen Creek stock of coho salmon would be achieved with index peak escapement counts ranging from about 80 to 210 spawners (Table 3; Part 3b). Although this estimate of the BEG range is reasonably similar to results obtained under the other two analyses, caution should be used with results from this analysis because the correlation between annual counts of coho salmon escapements into Auke Creek and Petersen Creek is very low ($R = 0.109$; see Figure 2).

The **rearing area analysis** indicates that the BEG for coho salmon spawning in Petersen Creek is 222 spawners or an index count of 56 spawners during a peak survey (Table 4). This BEG value of 56 index spawners is well below the range of escapements predicted to provide 90% of more of MSY with the **spawner-recruit analysis** and the **exploitation rate analysis** as is the case for the other four stocks of coho salmon returning to Juneau roadside streams.

My recommendation is to establish a BEG range of 100 to 350 coho salmon counted during a peak survey of Petersen Creek. I suggest using 200 coho salmon counted during a peak survey as the point BEG value for Petersen Creek. My recommended BEG range for peak survey counts encompasses the upper end of the range for the **spawner-recruit analysis** (Table 5) and incorporates an approximately average value calculated from the lower end of the ranges from all three analyses which were directed at establishing a BEG range that is likely to produce 90% or more of MSY from the Petersen Creek stock of coho salmon.

Steep Creek Coho Salmon

Since 1980, coho salmon index escapements in Steep Creek have ranged from 128 to 612 fish with the range of escapements included in the **spawner-recruit analysis** ranging from 128 to 515 index spawners, a 4-fold difference. The spawner-recruit relationship (Figure 5) developed for Steep Creek coho salmon has a moderate R^2 value ($R^2 = 0.591$). The BEG for Steep Creek coho salmon was estimated with the **spawner-recruit analysis** to be about 800 fish or an index value of about 160 spawners counted during the peak survey (Table 1; Part 1b). The escapements estimated to result in 90% or more of MSY from the Steep Creek

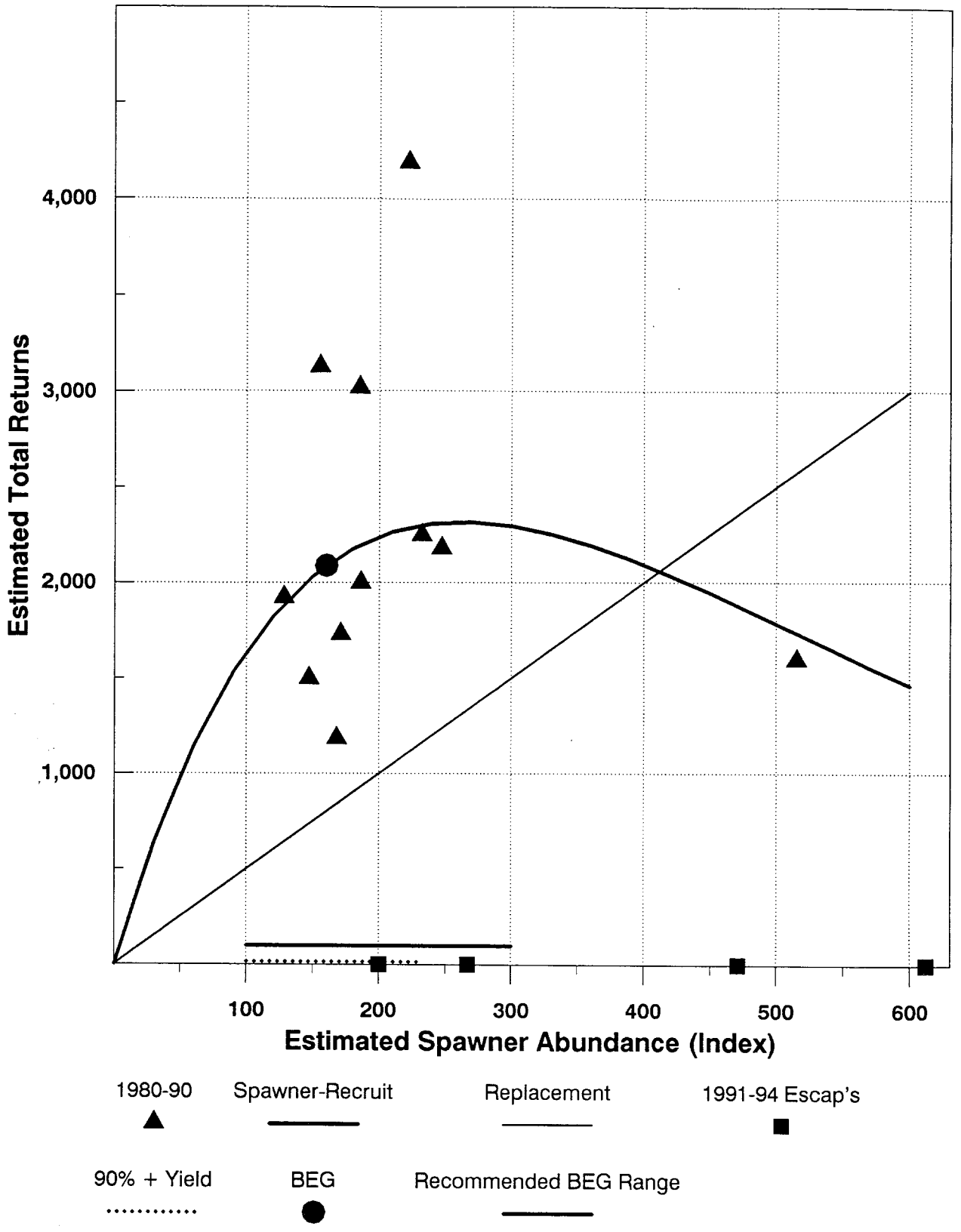

Figure 5. Spawner-recruit relationship for Steep Creek coho salmon.

stock of coho salmon with the **spawner-recruit analysis** ranged from about 500 to 1,150 spawners or index values ranging from about 100 to 230 spawners counted during peak surveys (Table 1; Part 1b). The **spawner-recruit analysis** indicates that coho salmon escapements into Steep Creek are often in the range of escapements expected to result in 90% of more of MSY (60% of the years since 1980; see Table 1; Part 1c); and that when escapements are not in the BEG range, they exceed the BEG range (40% of the years since 1980; see Table 1; Part 1c).

The **exploitation rate analysis** indicates that MSY would be achieved with lower escapements than the range indicated with the **spawner-recruit analysis**. The indicated BEG is about 450 spawners or an index peak count of about 90 spawners; approximately a 40% lower escapement level than the BEG indicated with the **spawner-recruit analysis** (Table 2; Part 2b). This is because the optimum harvest rate at the BEG in the **spawner-recruit analysis** is 62% or about 9% lower than the harvest rate calculated for Auke Creek coho salmon (71%). Either the **spawner-recruit analysis** provides an overestimate of the BEG or the coho salmon production potential of Steep Creek is lower than is the case for Auke Creek. The range of optimum harvest rates at BEG for other Southeast Alaska coho salmon stocks (Clark, Clark, and Shaul 1994) ranges from 68.1% for coho salmon returning to Ford Arm Lake to 81.4% for coho salmon returning to the Berners River; higher values than the value indicated for Steep Creek coho salmon. I suspect that the optimum harvest rate at BEG for Steep Creek coho salmon is somewhat higher than the **spawner-recruit analysis** indicates because the range of escapements included in the **spawner-recruit analysis** only varies about 4-fold. The **exploitation rate analysis** indicates that the escapements of coho salmon into Steep Creek typically exceed the range of escapements expected to result in MSY (67% of the years since 1980; see Table 2; Part 2c); all other escapements of coho salmon into Steep Creek fall within the estimated BEG range (33% of the years since 1980; see Table 2; Part 2c).

The **proportional escapements analysis** indicates that two-thirds of the escapements of coho salmon into Steep Creek since 1980 have exceeded the range of escapements expected to result in MSY while the other third have been in the range expected to result in 90% or more of MSY (Table 3; Part 3c). The **proportional escapements analysis** indicates that 90% or more of MSY for the Steep Creek stock of coho salmon would be achieved with index peak escapement counts ranging from about 60 to 180 spawners (Table 3; Part 3b). Although this range of index counts is reasonably similar to results obtained under the **exploitation rate analysis** and the **spawner-recruit analysis**, caution should be used with results from this analysis because the correlation between annual counts of coho salmon escapements into Auke Creek and into Steep Creek is low ($R = 0.408$; see Figure 2).

The **rearing area analysis** indicates that the BEG for coho salmon spawning in Steep Creek is 44 spawners or an index count of 9 spawners counted during a peak survey (Table 4). This BEG value of 9 index spawners is well below the range of escapements predicted to provide 90% of more of MSY with the other three types of analyses as is the case for the other four stocks of coho salmon returning to Juneau roadside streams.

My recommendation is to establish a BEG range of 100 to 300 coho salmon counted during a peak survey of Steep Creek. I suggest using 150 coho salmon counted during a peak survey as the point BEG value for Steep Creek.

Switzer Creek Coho Salmon

Since 1980, coho salmon index escapements in Switzer Creek have ranged from 7 to 227 fish with the range of escapements included in the **spawner-recruit analysis** ranging from 7 to 123 index spawners, more than a 17-fold difference. The spawner-recruit relationship (Figure 6) developed for Switzer Creek coho salmon has a high R^2 value (R^2 = 0.800). The BEG for Switzer Creek coho salmon was estimated with the **spawner-recruit analysis** to be about 85 fish or an index value of 34 spawners counted during the peak survey (Table 1; Part 1b). The escapements estimated to result in 90% or more of MSY from the Switzer Creek stock of coho salmon with the **spawner-recruit analysis** ranged from about 60 to 120 spawners or index values ranging from about 24 to 48 spawners counted during peak surveys (Table 1; Part 1b). The **spawner-recruit analysis** indicates that coho salmon escapements into Switzer Creek typically exceed the range of escapements expected to result in 90% of more of MSY (86% of the years since 1980; see Table 1; Part 1c).

The **exploitation rate analysis** indicates that MSY would be achieved with larger escapements than the range indicated with the **spawner-recruit analysis**. The indicated BEG is about 160 spawners or an index peak count of 64 spawners, about double the BEG suggested by the **spawner-recruit analysis** (Table 2; Part 2b). This is because the optimum harvest rate at BEG in the **spawner-recruit analysis** is 87% or about 16% higher than the optimum harvest rate calculated for Auke Creek coho salmon (71%). Either the **spawner-recruit analysis** provides an underestimate of the BEG or the coho salmon production potential of Switzer Creek is higher than is the case for Auke Creek. The optimum harvest rate value at BEG for Switzer Creek obtained with the **spawner-recruit analysis** of 87% is higher than the calculated values of 81.4% and 81.0% for the Berners River and Hugh Smith Lake stocks of coho salmon, respectively (Clark, Clark, and Shaul (1994), leading me to believe that the production potential of Switzer Creek more closely resembles that of these two systems than that of Auke Creek; and, leading me to believe that the **spawner-recruit analysis** still may have somewhat underestimated the BEG of the Switzer Creek stock of coho salmon. The **exploitation rate analysis** indicates that the escapements of coho salmon into Switzer Creek typically exceed the range of escapements expected to result in MSY (53% of the years since 1980; see Table 2; Part 2c).

The **proportional escapements analysis** indicates that the escapements of coho salmon into Switzer Creek typically exceed the range of escapements expected to result in MSY (73% of the years since 1980; see Table 3; Part 3c). The **proportional escapements analysis** indicates that 90% or more of MSY for the Switzer Creek stock of coho salmon would be achieved with index peak escapement counts ranging from about 20 to 70 spawners (Table 3; Part 3b). This range of index counts encompasses the BEG estimates obtained under the other two analyses. However, caution should be used with results from this

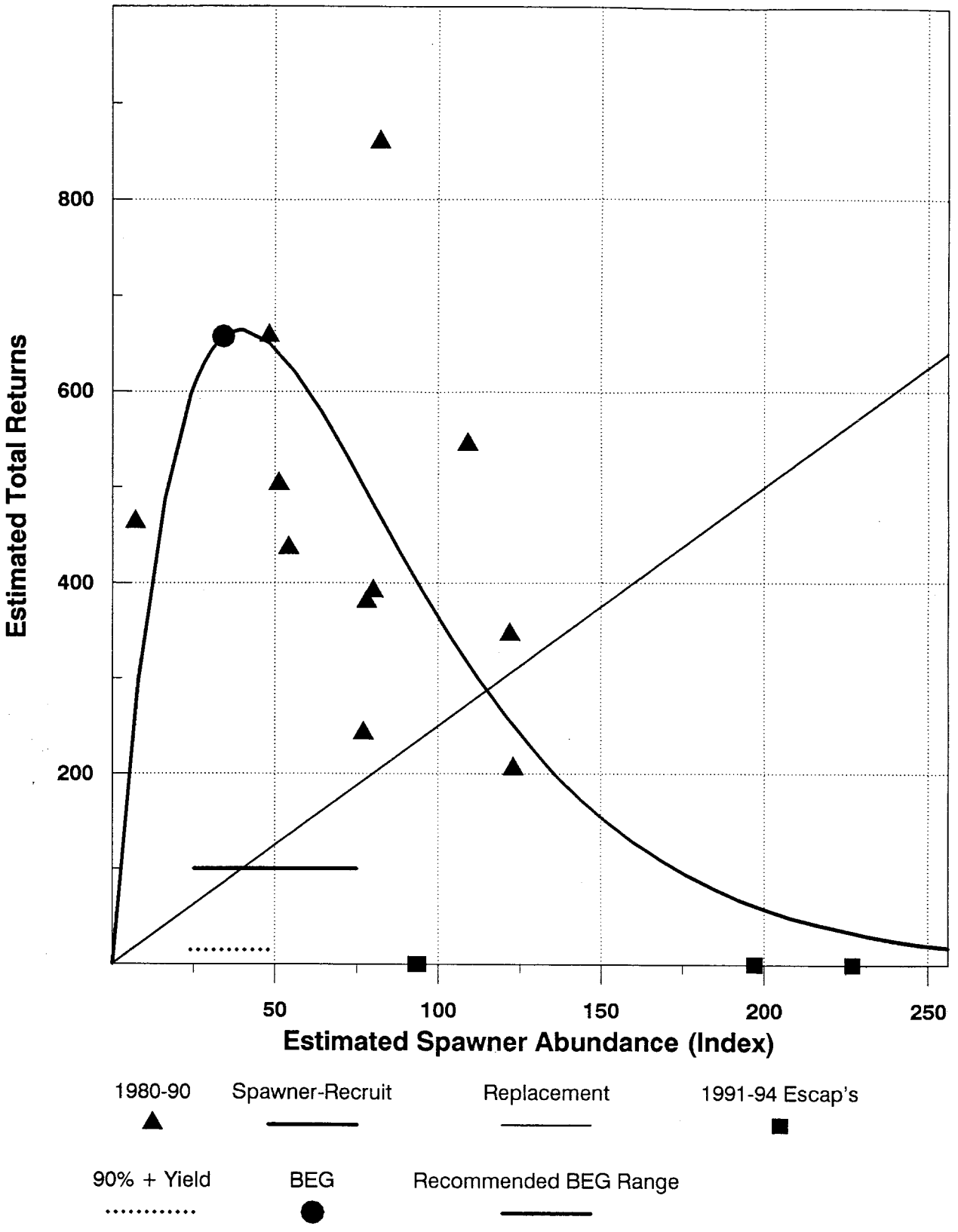

Figure 6. Spawner-recruit relationship for Switzer Creek coho salmon.

analysis because the correlation between annual coho salmon escapement levels in Auke Creek and Switzer Creek is only 0.309 (Figure 2).

The **rearing area analysis** indicates that the BEG for coho salmon spawning in Switzer Creek is 30 spawners or an index count of 12 spawners during a peak survey (Table 4). This BEG value of 12 index spawners is well below the range of escapements predicted to provide 90% of more of MSY with the other three types of analyses as is the case for the other four stocks of coho salmon returning to Juneau roadside streams.

My recommendation is to establish a BEG range of 25 to 75 coho salmon counted during a peak survey of Switzer Creek. I suggest using 50 coho salmon counted during a peak survey as the point BEG for Switzer Creek coho salmon (the approximate average BEG suggested from the three analyses. My recommended BEG range for peak survey counts encompasses the results of all analyses (Table 5) which were directed at establishing an escapement goal that is likely to produce 90% or more of MSY from the Switzer Creek stock of coho salmon.

RECOMMENDATIONS

After conducting this analysis and considering the results in concert with other escapement goal analyses for stocks of coho salmon in Southeast Alaska, I recommend that ADF&G formally adopt the following escapement goals for the coho salmon stocks that return to Jordan, Montana, Petersen, Steep and Switzer creeks:

	Recommended BEG (Peak Counts of Index Spawners)	
Stream	Point Escapement Goal	Escapement Goal Range
Jordan Creek	150	75 to 200
Montana Creek	450	200 to 500
Petersen Creek	200	100 to 350
Steep Creek	150	100 to 300
Switzer Creek	50	25 to 75

I recommend that this analysis be updated in about three years because an additional three years of spawner-recruit data points will be available at that time to add to the existing ten to eleven data points per stock included in this analysis. I recommend that coho salmon carcasses be collected and sampled for age-sex-size composition during surveys of Jordan, Montana, Petersen, Steep, and Switzer creeks; this will improve the ADF&G data base and understanding of the age composition of these stocks and lead to improved spawner-recruit models in future years. I recommend that the research begun in 1994 to estimate total coho salmon spawner abundance in Steep Creek be continued and expanded to other Juneau roadside streams to improve and extend the ADF&G data base concerning appropriate expansion factors for peak survey counts. Further, I recommend that ADF&G formally develop an operational plan that lays out how surveys of Juneau roadside streams will be conducted to enumerate coho salmon; and, that this plan provide specifics concerning dates of surveys and specific areas of the streams to be surveyed along with other specifics and details pertinent to a formal ADF&G operational plan.

POSTSCRIPT

A draft of this report was prepared on August 5, 1994. The draft report was provided to several ADF&G staff members for review and comment. A formal interdivisional team composed of the following ADF&G staff members reviewed the report and considered the technical basis of the analyses and BEG recommendations:

Michael R. Bethers, Sport Fish Division;
John E. Clark, Commercial Fisheries Management and Development Division;
Steven T. Elliott, Sport Fish Division;
David Gaudet, Commercial Fisheries Management and Development Division;
Scott A McPherson, Sport Fish Division; and,
Leon D. Shaul, Commercial Fisheries Management and Development Division.

After review of the draft report, this interdivisional team recommended to Paul V. Krasnowski, the Director of the Sport Fish Division of the Alaska Department of Fish and Game that ADF&G formally adopt the recommended BEGs. On September 19, 1994, Director Paul V. Krasnowski utilized his authority and adopted the recommended BEGs as formal biological escapement goals on behalf of the Alaska Department of Fish and Game.

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